# 5.4 continued Voltage

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(Electric Potential and Potential Difference)

**Electric potential** (V) is the electric potential energy ($E_p$) per unit charge ($Q_t$)

Voltage or Electric Potential → $V = \frac{E_p}{Q_t}$ ← $Q_t$: charge that is in the $\vec{E}$ (Electric field)

$[\text{Volts}] = [V] = \left[\frac{J}{C}\right]$

- V is used to describe the effect of a source's electric field in terms of the location in the field
  - as the amount of charge changes, the $E_p$ will change, but as long as the distance from the source stays the same, the electric potential (V) will be the same.

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**Practice pg 194 # 1-3** using $V = \frac{E_p}{Q_t}$

Another version of the Elec. Potential formula:

$$V = \frac{E_p}{Q_t} = \frac{\frac{K \cancel{Q_t} Q_s}{R}}{\cancel{Q_t}}$$

$$\boxed{V = \frac{K Q_s}{R}}$$

$Q_s$: source charge

$R$: distance from source charge

(Note: electric potential will be zero at ∞ from source charge)

distance from Source charge        Source charge)

**Practice pg 195 #1-2**        using $V = \frac{kQ_s}{R}$

## Electric Potential Difference ($\Delta V$)

- the amount of work required to move a charge from lower potential energy ($E_{pA}$) to higher ($E_{pB}$)
  (i … f)

$$\Delta V = \frac{W}{Q_t} = \frac{\Delta E_p}{Q_t} = \frac{E_{pB} - E_{pA}}{Q_t}$$

$\Delta V$ ← potential difference or voltage

$$\boxed{\Delta V = \frac{\Delta E_p}{Q_t}}$$

(§5.5 but needed for #3 pg 196
for uniform field between parallel plates

$$\vec{E} = \frac{\Delta V}{d}$$

$\vec{E}$ — Electric Field
$\Delta V$ — pot. diff. between plates
$d$ — distance between plates )

## Electron Volts (unit conversion between eV and J)

- the amt of energy gained as one $e^-$ moves through a potential difference of one Volt.

$$(Q_{e^-})(1V) = 1eV = 1.6\times10^{-19}\,J$$

ex 500eV → J

$$500\,eV \times \frac{1.6\times10^{-19}\,J}{1\,eV} = 8.0\times10^{-17}\,J$$

ex $3.2\times10^{-16}\,J \rightarrow eV$

$$3.2\times10^{-16}\,J \times \frac{1\,eV}{1.6\times10^{-19}\,J} = 2000\,eV$$

Practice pg 196 #1-3
pg 197 #1-2